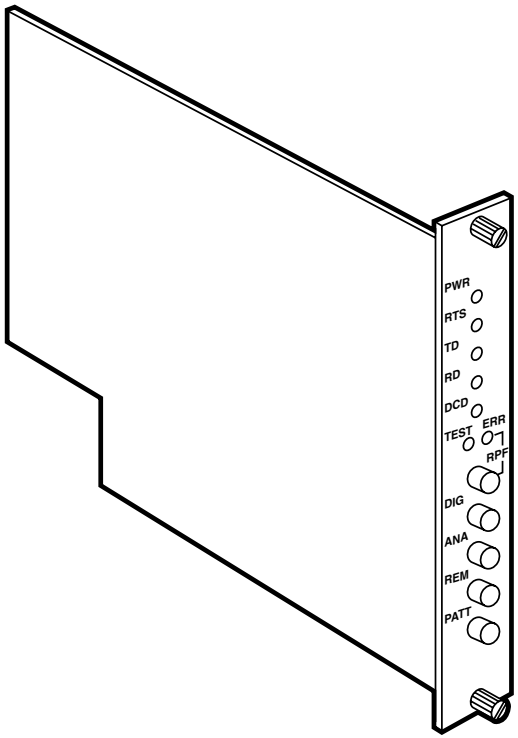
AUGUST 1997
ME445C-35
ME445C-530
ME445C-X.21

256-Kbps Line-Driver (LDM-256) Cards



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RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

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1. Specifications

Compliance — FCC Class A, DOC Class/MDC classe A

Standards — Loopback tests: ITU-TSS V.54;
BERT: ITU-TSS V.52

Interfaces — Line side: ITU-TSS G.703;
Device side:
ME445C-35: ITU-TSS V.35;
ME445C-530: EIA/TIA RS-530;
ME445C-X21: ITU-TSS X.21

Protocol — Synchronous

Clock Source — Internal, external (from attached device), or recovered (from remote Card)

Flow Control — None

Operation — 4-wire, full- or half-duplex, point-to-point or multipoint

Data Rate — 256, 192, 144, 128, 112, 96, 72, 64, 56, 48, 32, or 19.2 kbps (user-selectable)

Maximum Distance — See the tables in the **Appendix**

User Controls — (5) Front-mounted pushbuttons for loopback testing, BERT, and remote-power-failure adjustment;
(1) Board-mounted data-rate screwdial;
(14) Board-mounted jumpers and (1) [nonfunctional] board-mounted 3-position DIP switch for timing, testing, signal levels/impedances, and other features

Indicators —	(7) Front-mounted LEDs: PWR (power), RTS, TD, RD, DCD, TEST, ERR (error)
Connector —	38-contact card-edge male, electrically connected to a DB25 female on the RackNest 2/14 when the Card is installed
Leads/Signals Supported —	See Tables 4-2 through 4-4 (**Chapter 4**)
MTBF —	75,500 hours
Maximum Altitude —	8000 ft. (2438.4 m)
Temperature Tolerance —	32 to 122˚F (0 to 50˚C)
Humidity Tolerance —	Up to 90% noncondensing
Power —	From the RackNest 2/14; Consumption: 5 watts
Size —	6.2"H x 0.9"W x 9.0"D (15.7 x 2.5 x 23 cm)
Weight —	0.8 lb. (0.4 kg)

2. Introduction to the Cards

The 256-kbps Line-Driver (LDM-MR256) Cards are short-range modems for synchronous transmission—full- or half-duplex—over unconditioned lines. With a range of up to 11.8 miles (19 km), the Cards operate at user-selectable data rates from 19.2 to 256 kbps.

The LDM-256 Cards use conditional differential diphase modulation (EUROCOM Std. D1) to provide immunity from background noise, eliminate normal line distortion, and enable efficient transmission and reception of serial data over a twisted-pair cable. Each Card is coupled to the line through isolation transformers which, in conjunction with protective circuitry, safeguard against AC or DC overvoltages. With this protective circuitry, the LDM-256 can operate even when DC is connected to the line.

Transmit timing is provided internally, derived externally from the PC or terminal, or regenerated from the Receive signal. Receive timing is always regenerated from the Receive signal.

The LDM-256 features V.54 diagnostic capabilities for local analog loopback and local and remote digital loopback testing. In the digital loopback mode, the operator at either end of the line may test both modems and the line. The loopback is controlled either by pressing front-panel pushbuttons or by manipulating signals on the DTE interface.

The LDM-256 incorporates a built-in Bit Error Rate Tester (BERT). The internal BERT enables complete testing of both modems and the line without external test equipment. Pressing the LDM-256's front-panel PATT button causes the unit to generate a pseudo-random test pattern (511-bit, according to ITU-TSS V.52) for testing end-to-end connectivity. The ERR LED flashes when a bit error occurs.

2.1 Physical Description

The LDM-256 is designed as a desktop unit only, but can be mounted in a 19-inch rack with optional brackets (see **Section 3.3**). For descriptions of its controls and indicators, see **Section 4.1**.

2.2 Functional Description

This section describes the operation of the LDM-256's circuit blocks, primarily the circuits required for correctly configuring the modem (see Figure 2-1).

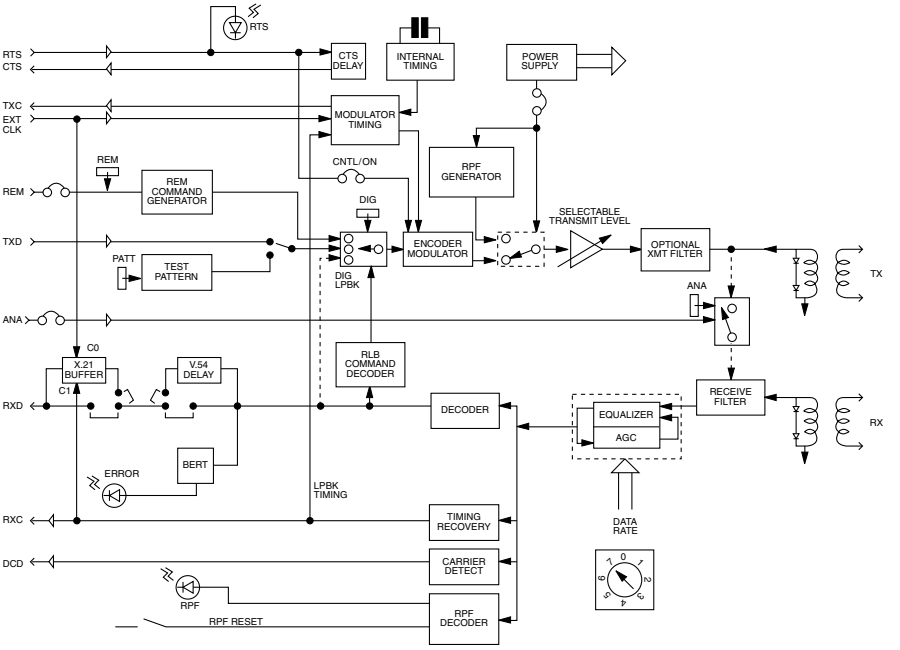

Figure 2-1. LDM-256 block diagram.

2.2.1 Encoder Modulator

The encoder modulator receives data from the DTE, then modulates the data using the "conditional diphase modulation" technique. You can configure the encoder to operate in one of three modes:

- 4-wire full-duplex (point-to-point)
- 4-wire half-duplex (point-to-point)
- 4-wire multipoint

The appropriate mode is determined by the setting of two jumpers: CARRIER (J2) and RTS-CTS DLY (J4). For multipoint applications, two additional jumpers must be set: XMT IMP (J13) and RCV IMP (J10). See **Chapter 3** for a more detailed explanation of the correct jumper settings.

NOTE

In multipoint applications, do not use the 0-msec option for the RTS-CTS delay.

2.2.2 Modulation Timing

This circuit supplies the transmit clock to the encoder. Three clock sources are available on the XMT CLK jumper (J3):

- **INT**—Internal clock. From the modem's internal crystal oscillator.
- **EXT**—External clock. From DTE.
- **RCV**—Receive clock. Recovered from the receive signal.

There is also an **ASY** (asynchronous) setting, but this has no function and should not be selected.

2.2.3 Signal Levels

Two options are available for the transmit and receive signal levels: 0 and –6 dBm. You can control the transmit level with the XMT LVL jumper. You can control the receive level with the RCV LVL jumper.

2.2.4 Receiver

The receiver comprises several circuits, as shown in the block diagram (see Figure 2-1):

- The **RECEIVE FILTER**, which removes all the out-band frequencies.
- The **EQUALIZER**, which comprises several equalizers activated according to data rate.
- The **digital Automatic Gain Control (AGC)**, which automatically compensates for the attenuation of the line.

2.2.5 V.54 Diagnostics

V.54 loops are activated manually with the front-panel pushbuttons, or through the DTE interface. The pushbuttons and the DTE interface can be enabled or disabled separately by the ANA, REM, and SWITCH jumpers.

When you use the LDM-256 as a tail-end to a digital network, the V.54 DLY jumper in the modems located close to the network should be set to ON to prevent multiple loopbacks. The delay switch is used to prevent the last modem from receiving the complete V.54 data sequence and, in turn, being induced into a loop.

2.2.6 Test-Pattern Generator and Receiver

This feature allows for easy and quick testing of the local modem as well as the communication link. When the PATT button on the front panel is pressed, the circuit sends and checks a standard 511-bit pseudo-random pattern. If the modem encounters errors, the ERR LED remains ON or blinks.

The test can be carried out in local analog loopback, in remote digital loopback, or in normal point-to-point operation opposite a remote LDM-256 modem. Press the PATT pushbutton on the remote unit or connect a Bit Error Rate Tester that uses the standard 511-bit pattern.

2.3 Applications

The diagrams on this page and the following pages illustrate the LDM-256 operating in various applications.

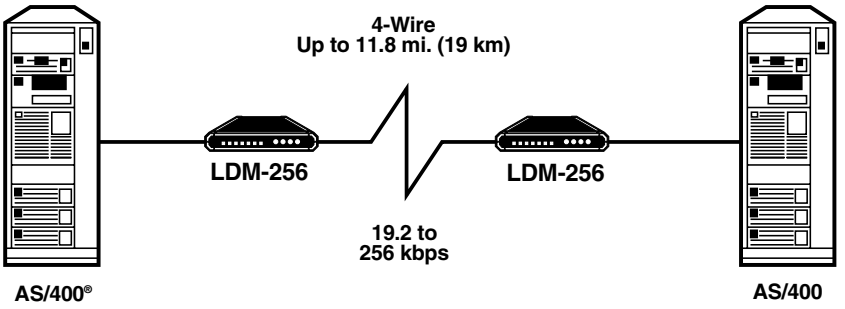

Figure 2-2. Point-to-point application.

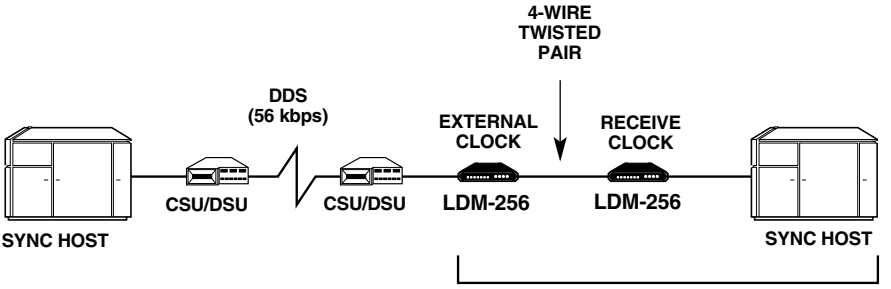

Figure 2-3. Tail-circuit application.

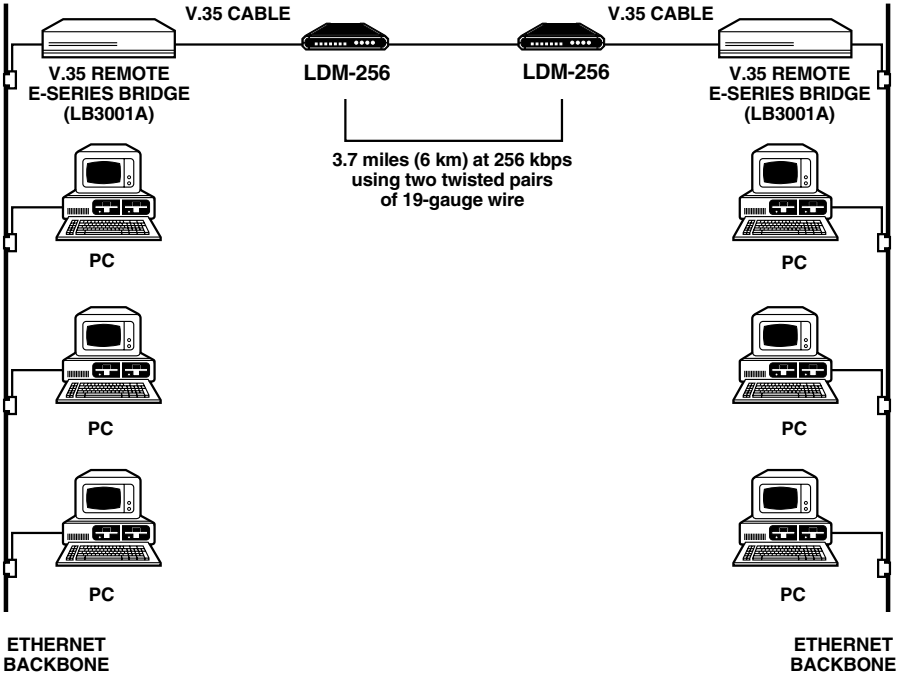

Figure 2-4. LAN application—extending the distance between two networks.

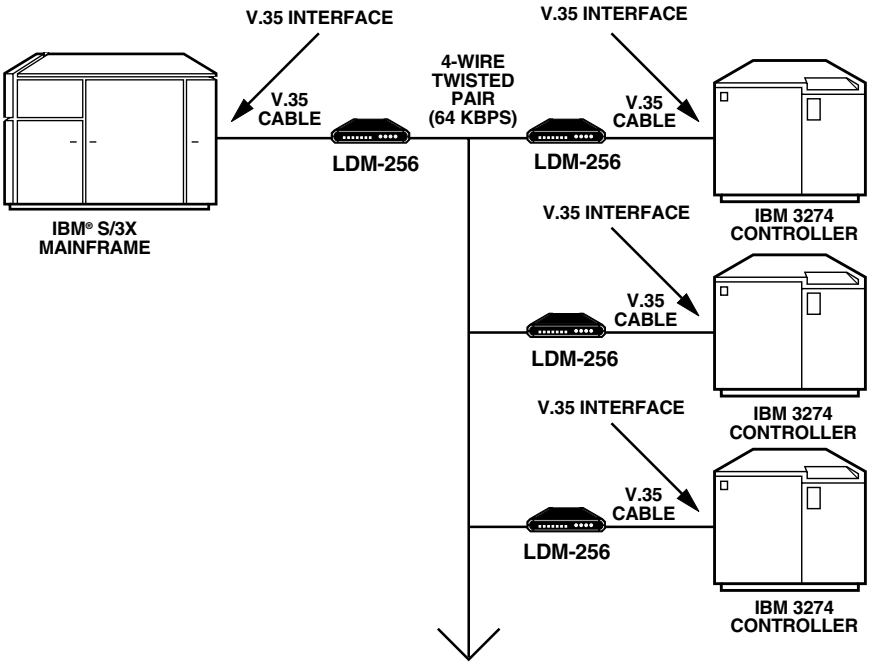

Figure 2-5. Multipoint application.

3. Introduction to the RackNest 2/14

This chapter describes the RackNest 2/14, in which you will be installing your LDM-256 Card.

3.1 Description of the RackNest 2/14

The RackNest 2/14 is a special 19" rack component designed to host a number of our short-haul modems and line drivers. As shown in Figures 3-1 and 3-2, it consists of a rack chassis (with one or two power supplies) into which you can plug as many as 14 modem or driver cards.

The Nest's rear panel consists of fourteen five-screw terminal blocks ("TB1") and fourteen connectors ("J1"). Each terminal block ("TB1") provides four screws for connecting Nest-to-Nest G.703 transmit and receive lines—the transmit pair can be connected to the terminals marked XMT, and the receive pair can be connected to the terminals marked RCV—plus a fifth screw for ground connection.

Each interface connector ("J1") is a DB25 female. The pinning of this connector depends on the type of Card installed in the corresponding slot, because the Cards will present and expect different signals on different pins. For the V.35 model of the LDM-256 Card (ME445C-35), the pinning is a special V.35-on-DB25 variant; for the RS-530 and X.21 models, the pinning is RS-530. Refer to Tables 4-2 through 4-4 (**Chapter 4**) for the pinouts of this connector, and for the pinning of the adapters or adapter cables that will be necessary to attach a V.35 or X.21 DTE to this connector.

3.2 Description of the RackNest 2/14's Power Supply

The 115-VAC RackNest 2/14 (our product code RM110A) uses the PS1000A power supply, which accepts 115-VAC input power. The 230-VAC RackNest 2/14 uses power supply PS1000AE, which accepts 230-VAC input power. Each of these power supplies consists of a power-line transformer and a fuse. The 115-VAC Nest can also be ordered with dual power supplies (our product code RM110A-2PS); either of these power supplies can be hot-swapped if it fails.

All power-regulating circuitry for the RackNest 2/14 is located on the card modems themselves. Each card has two fuses which protect the entire system against power failure due to a short circuit in one card. Primary power needed is 115 or 230 VAC ±10%, 47 to 63 Hz, at 24 VA maximum.

AC power should be supplied to the RackNest 2/14 through a standard power cable run between the AC mains socket on the rear of the Nest's power-supply module—an IEC 320 male power inlet which contains an integral fuse—and a standard, grounded, easily accessible AC outlet. (If your Nest is an RM110A, you can use the power cord supplied with it; if your Nest is an RM110AE, use a power cord appropriate for your site's mains outlets.)

The Nest begins operating and supplying power to the installed Cards as soon as it is plugged into a mains outlet, and will continue operating until it is unplugged.

WARNING!

This unit should always be grounded through the protective earth lead of the power cable. Before AC power is connected to this unit, the mains plug should only be inserted into a socket outlet provided with protective earth contact. The protective action must not be negated by use of an extension cord without a grounding conductor.

Whenever it is likely that the unit's fuse (located in a bayonet-type fuse holder on the unit's rear panel) has been blown or damaged, make the unit inoperative and secure it against unintended operation until the fuse can be replaced. Make sure that only fuses of the required rating, as marked on the rear panel, are used for replacement. Do not use repaired fuses or short-circuit the fuse holder. Always disconnect the mains cable before removing or replacing the fuse.

Interrupting the grounding conductor, inside or outside the unit, or disconnecting the protective earth contact, can make this unit dangerous!

3.3 The RackNest 2/14 Illustrated

You will be installing the LDM-256 Card in the RackNest 2/14 as shown in Figure 3-1 below. The front and rear panels of the Nest are shown in Figure 3-2; the numbered connectors, controls, and indicators are described in Table 3-1.

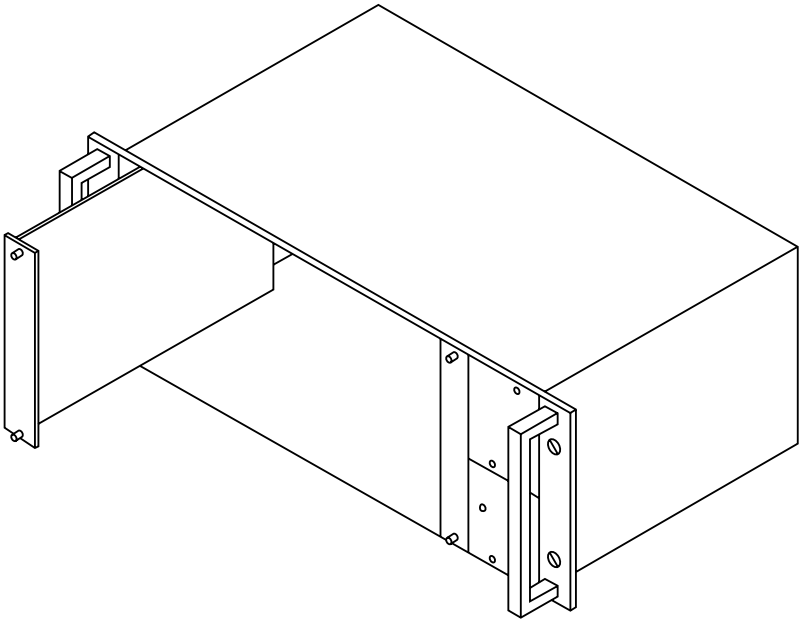

Figure 3-1. The RackNest 2/14: Card installation.

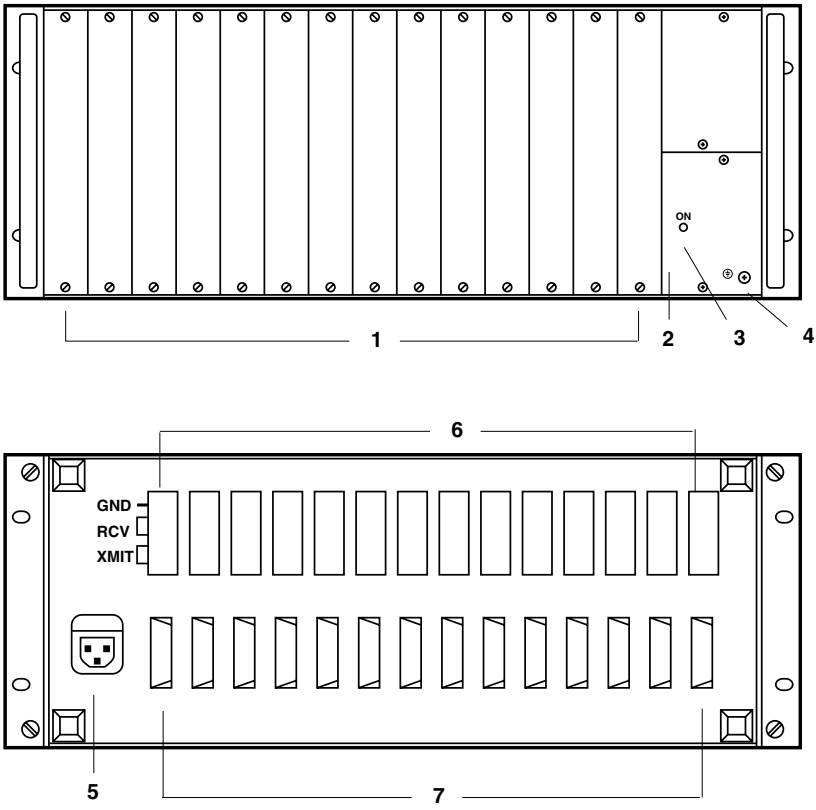

Figure 3-2. The RackNest 2/14 illustrated.

Table 3-1. Descriptions of RackNest 2/14 Components

Item	Control, Indicator, or Connector	Function
1	Card Slots	Slots for installation of compatible cards (slot no. 1 located at the left-hand side). Unused slots are closed with blank panels.
2	Power-Supply Module	Provides power to modules installed in the enclosure.
3	ON Indicator	Lights when power supply is operating.
4	Chassis-Ground Terminal	Connector for attaching other grounds, devices, etc., to the Nest's chassis ground (optional).
5	Power Connector	Power connector with integral fuse.
6	Main Channel Connectors (J1)	DB25 connectors for the module DTE connection.
7	4-Wire Terminal Blocks (TB1)	For connection of 4-wire lines. Each modem card has a separate terminal-block connector.

4. Configuration and Installation

This chapter explains how to configure your LDM-256 Card and how to install it in the RackNest 2/14. After you install the Card, see **Chapter 5** for how to operate it and **Chapter 6** for how to test the system.

4.1 Configuration

Before putting the LDM-256 Card in the RackNest 2/14 or attaching anything to the Card, determine which data rate you're going to use, what the system's clock source should be, and how you want to set all of the other user-configurable options on the Card. (Refer to Table 4-1 for a list of all of these options; the SW*n* and J*n* numbers in the table's "Element" column correspond to the locations with the same numbers in Figure 4-1.)

When you have everything at least tentatively decided, identify the control(s) on the Card whose settings you want to change (refer to Figure 4-1), then move the control(s) to your desired position(s).

CAUTION!

Make sure the Card is disconnected from the RackNest 2/14 and from all sources of electric power.

WARNING: HIGH VOLTAGE!

Any adjustment, maintenance, and repair of the Card under voltage should be avoided as much as possible, and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors on the Card may still be charged even after the Card has been disconnected from the power source.

Table 4-1. User-Configurable Options

Element	Function	Possible Settings	Standard Factory Setting
SW3 BAUD RATE Dial	Select the data rate in kilobits per second.	Opt. 1 F-256 0-192 1-144 2-128 3-112 4-96 5-72 6-64 7-56 8-48 9-32 D-19.2	 64 kbps
J1 V54 DIS Jumper	Enable or disable requests for V.54 digital loopback tests from the remote LDM-256.	DIS EN	EN (enabled)
J2 CARRIER Jumper	Select the Transmit-carrier mode. When you set this jumper to "ON," Transmit carrier is constantly ON. When you set this jumper to jumper to "CNTRL," Transmit carrier is ON only when RTS is high. Use the CNTRL setting for multipoint applications.	CNTRL ON	ON
J3 XMT CLK Jumper	Select the source of the Transmit timing signal: internal clock, external clock (from DTE), or receive clock (from remote unit). Do not select the ASY (asynchronous, no clock) setting.	INT EXT RCV ASY	INT (Internal)
SW2 Data-Format DIP Switch	[This switch only comes into play when ASY (asynchronous) is selected on jumper J3. ASY should never be selected on this unit, so the settings of this switch are irrelevant.]		
J4 RTS-CTS DLY Jumper	Select the delay in milliseconds that occurs during RTS-to-CTS transitions. Do not select 0 for multipoint applications.	0 9 70	 9 ms
J5 V54 DLY Jumper	Turn V.54 delay ON or OFF. When you turn it ON, V.54 delay prevents multiple loopback of tail-end circuits.	ON OFF	OFF
J6 SW. EN. Jumper	Enable or disable the DIG, ANA, and REM loopback-control buttons on the unit's front panel.	ON OFF	ON (enabled)

Table 4-1. User-Configurable Options (continued)

Element	Function	Possible Settings	Standard Factory Setting
J7 RLB DTE* Jumper	Enable or disable electronic control of remote digital loopback testing through the DTE interface.	EN DIS	EN (enabled)
J8 ALB DTE* Jumper	Enable or disable electronic control of local analog loopback testing through the DTE interface.	EN DIS	EN (enabled)
J9 RCV LVL Jumper	Select the level (in dBm) of Receive input from the line.	-6 0	0 dBm
J10 RCV IMP Jumper	Select the Receive-line impedance. In multipoint applications, it is advisable to set the master modem and the last modem in the line to 150 Ω, and all others to HIGH.	150 [Ω] HIGH	150 ohms
J11 RPF. Jumper	Enable or disable the Remote Power Failure feature.	ON OFF	ON
J12 XMT LVL Jumper	Select the level (in dBm) of Transmit output to the line.	-6 0	0 dBm
J13 XMT IMP Jumper	Select the Transmit-line impedance in ohms. In multipoint applications, it is a good idea to set the master modem to "LOW."	150 [Ω] LOW	150 ohms
J14 CHASS Jumper	Set to CON to connect Signal Ground to Chassis Ground. Set to DIS to keep the two grounds isolated from each other.	DIS CON	CON (connected)

***NOTES:** If the DTE does not provide the test pins for analog and remote loopback, the ALB DTE and RLB DTE jumpers must be always set to DIS.

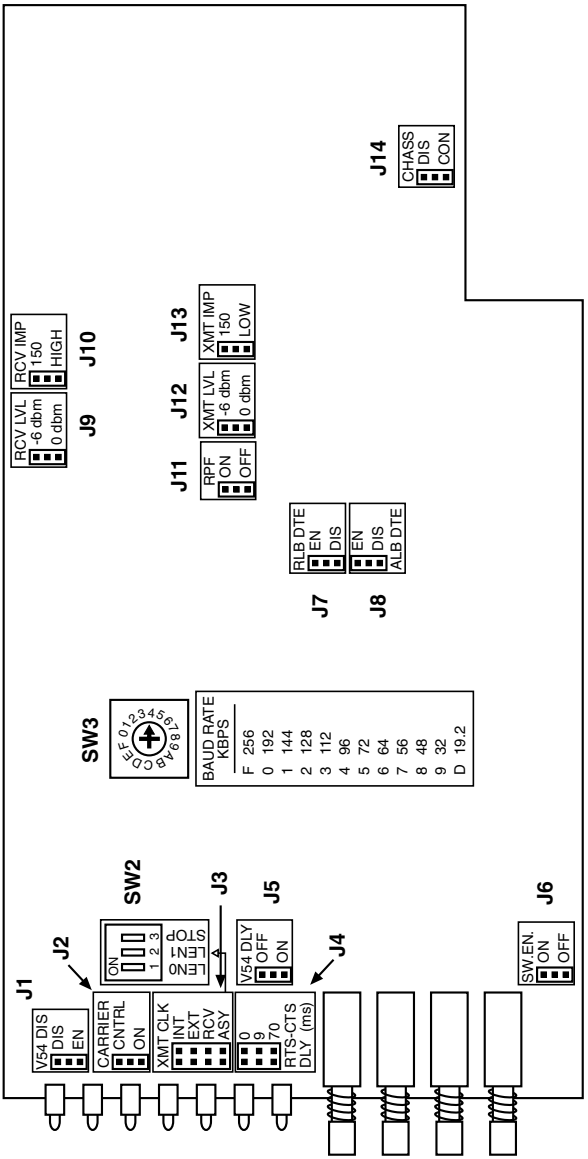

Figure 4-1. Layout of the LDM-256's printed circuit board.

4.2 The Installation Procedure

After you install the RackNest 2/14 in your 19" rack (refer to the Nest's manual), take these steps to install an LDM-256 Card in the Nest:

1. Insert the Card into an empty slot on the Nest (see Figure 3-1). Do not use excessive force. If the Card does not go in easily, remove the Card, realign it with the Nest's enclosure guides, and push it into place.

NOTE

When the RackNest 2/14 is ON, personnel are not exposed to any voltage over 30V on any card or accessible area of the Nest. Still, take all reasonable precautions to avoid electric shock.

2. Tighten the nut on the top of the Card.

3. Push the bottom of the Card as far into the Nest as it will comfortably go, to ensure that its card-edge connector makes full contact with the Nest's.

4. Run an appropriate cable from your DTE to the corresponding DB25 connector ("J1") on the back of the Nest:
   - *ME445C-530 (RS-530) units:* You can use standard RS-530 (DB25 male-to-male) cable. Refer to Table 4-2 for more information.
   - *ME445C-35 (V.35) units:* Either this cable needs to be specially pinned (see Table 4-3) and have a DB25 male connector at the Nest end and an M/34 male connector at the DTE end, or you need to use a correctly pinned, short DB25-male-to-M/34-female cable or similar adapter to patch between the V.35 (M/34 male-to-male) cable and the Nest's DB25 connector. Call Black Box for a quote on this type of cable.
   - *ME445C-X21 (X.21) units:* Either this cable needs to be pinned for RS-530 to X.21 (see Table 4-4) and have a DB25 male connector at the Nest end and a DA15 ("DB15") male connector at the DTE end, or you need to use a correctly pinned, short DB25-male-to-DA15-female cable or similar adapter to patch between the X.21 (DA15 male-to-male) cable and the Nest's DB25 connector. Call Black Box for a quote on this type of cable.

5. If you haven't already done so, install the remote RackNest 2/14. Repeat steps 1 through 4 at the remote site.

6. Run twisted-pair cable between the local and remote cards. Attach one pair of wires to the corresponding XMT terminals ("TB1") on the back of the local Nest and the corresponding RCV terminals on the remote Nest; attach the other pair of wires to the RCV terminals on the local Nest and the XMT terminals on the remote Nest. (It doesn't matter which wire in each pair goes to which terminal in each pair; the cards autosense parity.) If you're using a ground wire, attach it to the GND terminal on one Nest (*not* both of them!).

Table 4-2. Pinout of the RackNest 2/14's DB25 Connector When ME445C-530 Is Installed

SIGNAL NAME (ABBREV.)	ITU-TSS CIRCUIT	LEAD TYPE	DB25 PIN
Shield (SHD)	101		1
Signal Ground (SGND)	102		7
Transmitted Data (TD)	103	A B	2 14
Received Data (RD)	104	A B	3 16
Request to Send (RTS)	105	A B	4 19
Clear to Send (CTS)	106	A B	5 13
DCE Ready (DCR) a.k.a. Data Set Ready (DSR)	107	A B	6 22
Data Terminal Ready (DTR)	108	A B	20 23
Received Line Signal Detector (RLSD), a.k.a. Carrier Detect (CD)	109	A B	8 10
Transmitter Sig. Elem. Timing (DTE Source) (TSETT), a.k.a. External Clock (EXTC)	113	A B	24 11
Transmitter Sig. Elem. Timing (DCE Source) (TSETC), a.k.a. Transmit Clock (TC)	114	A B	15 12
Receiver Sig. Elem. Timing (DCE Source) (RSETC), a.k.a. Receive Clock (RC)	115	A B	23 22
Remote Loopback (RL)	140		21
Local Loopback (LL)	141		18
Test Mode (TM)	142		25

Table 4-3. Pinout of the RackNest 2/14's DB25 Connector When ME445C-35 Is Installed

SIGNAL NAME (ABBREV.)	ITU-TSS CIRCUIT	LEAD TYPE	DB25 (RACK-NEST) PIN	M/34 (NORM. V.35) PIN
Frame (Protective) Ground (FGND)	101		1	A
Signal Ground (SGND)	102		7	B
Send Data (SD)	103	A B	9 11	P S
Receive Data (RD)	104	A B	12 13	R T
Request to Send (RTS)	105		4	C
Clear to Send (CTS)	106		5	D
Data Set Ready (DSR)	107		6	E
Data Terminal Ready (DTR)	108		20	H
Received Line Signal Detector (RLSD), a.k.a. Carrier Detect (CD)	109		8	F
Serial Clock Transmit External (SCTE), a.k.a. External Clock (EXTC)	113	A B	19 16	U W
Serial Clock Transmit (SCT), a.k.a. Transmit Clock (TC)	114	A B	14 10	Y AA, a
Serial Clock Receive (SCR), a.k.a. Receive Clock (RC)	115	A B	23 22	V X
Remote Digital Loopback (RL)	140		21	HH, h*
Local Analog Loopback (LL)	141		18	JJ, j*
Test Mode (TM)	142		25	KK, k*

*Black Box often assigns these signals to these M/34 pins, but your DTE might use different pins (if it supports these signals at all). Consult your DTE's manual.

Table 4-4. Pinout of the RackNest 2/14's DB25 Connector When ME445C-X21 Is Installed

SIGNAL NAME (ABBREV.)	ITU-TSS CIRCUIT	LEAD TYPE	DB25 (RACK-NEST) PIN*	DA15 (NORM. X.21) PIN
Shield (n/a)	101		1	1
Ground (G) a.k.a. Signal Ground (SGND)	102		7	8
Transmit (T)	103	A B	2 14	2 9
Receive (R)	104	A B	3 16	4 11
Control (C) a.k.a. Request to Send (RTS)	105	A B	4 19	3 10
Indication (I) a.k.a. Carrier Detect (CD)	109	A	8 10	5 12
RS-530: Transmitter Signal Element Timing (DTE Source) (TSETT)†	113	A B	24 11	7† 14†
Signal Timing (S)	114	A B	15 12	6 13

*This pinout follows the TIA RS-530 standard.

†Standard X.21 does not support an external clock, and specifies that DA15 Pins 7 and 14 should be used for the Byte Timing (B) A and B signals. Because Byte Timing is hardly ever used, but an external clock is often necessary for today's data communication, many Black Box devices are designed to this modified specification in which the RS-530 external-clock signal replaces Byte Timing.

5. Operation

This chapter contains a list of the LDM-256 Cards' controls and indicators and their functions, as well as a brief description of how to operate the unit. Installation procedures must be completed and checked before you attempt to operate the LDM-256.

5.1 Controls and Indicators

The front panel of the LDM-256 is shown in Figure 5-1. It contains all of the unit's external controls and indicators: four pushbutton switches and seven LEDs. The functions of the controls are described in Table 5-1, and the meanings of the indicators are described in Table 5-2. In each of these tables, the letters and numbers under the heading "Item" correspond to the letters and numbers in Figure 5-1.

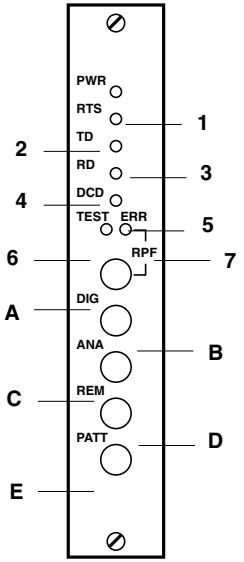

Figure 5-1. The front panel of the LDM-256 Cards.

Table 5-1. The Controls

The Item labels in this table correspond to those in Figure 5-1.

ITEM	CONTROL	FUNCTION
A	RPF	If jumper J11 is set to ON, pressing the Remote Power Fail button after a power failure at the remote site has been remedied causes the local LDM-256 to reset itself (the ERR LED goes dark, the Card resumes operating).
B	DIG	Pressing the local digital loopback button causes the local LDM-256 to loop received data and clock to its transmitter. Data Set Ready goes low.
C	ANA	Pressing the local analog loopback (V.54 Loop 3) button causes the local LDM-256 to loop its transmitter output back to its receiver. This loopback may also be activated from the DTE when the “ALB DTE” jumper is set to EN.
D	REM	Pressing the remote digital loopback (V.54 Loop 2) switch causes the remote LDM-256 to loop received data and clock to its transmitter. Data Set Ready goes low. This loopback may be also activated from the DTE when the “RLB DTE” strap is set to EN.
E	PATT	Pressing the PATT button causes the LDM-256 to send and receive a 511 test pattern. If errors are encountered, the ERR LED becomes steadily lit or blinks. Receive Data and Clear to Send go low. Note: The unit’s “CARRIER” jumper should be set to ON; if it is set to CNTRL, the RTS signal must be high.

Table 5-2. The Indicators

The item numbers in this table correspond to Figure 5-1.

ITEM	INDICATOR	FUNCTION
1	PWR	Green LED is on when power is on.
2	RTS	Yellow LED is on when terminal activates Request to Send.
3	TD	Yellow LED is on when steady SPACE is being transmitted. It flickers when data is transmitted.
4	RD	Yellow LED is on when steady SPACE is being received. It flickers when data is received.
5	DCD	Yellow LED is on when a valid Receive signal is present.
6	TEST	Red LED is on when the LMD-256 is in any of the loopback modes.
7	ERR	LED goes ON when PATT switch is activated and then dims. If there are errors in the test pattern, the LED blinks or remains ON.

5.2 Operating Procedure

The LDM-256 operates entirely unattended, although we recommend that you monitor its LEDs occasionally. To turn the Card off, you must remove it from the RackNest 2/14—it has no power switch.

If you want to reconfigure the LDM-256 for a different type of operation, *always* remove it from the Nest first, then change the settings of its board-level controls as necessary, following the instructions in **Section 4.1**.

6. Troubleshooting

The LDM-256 provides local loopback and remote digital loopback in compliance with the V.54 standard. Unless you disable them, the unit's loopback tests can be activated manually from the unit's front panel, and the local analog and remote digital loopbacks can be activated electronically through the DTE connection.

6.1 Loop Tests

The loop-test buttons (DIG, ANA, and REM) and LEDs built into the LDM-256 allow you to rapidly check the unit, the attached cables, and the attached DTEs. Use the test procedures described in this chapter to verify normal system operation and to isolate faulty equipment if a failure occurs. (Before testing the operation of the system equipment and line circuits, make sure that all devices are turned on and are properly configured.)

6.2 The Bit-Error-Rate Tester (BERT)

You can activate the LDM-256's internal Bit Error Rate Tester in any diagnostics test in which the transmitted test pattern is looped back to the BERT for comparison. An example is shown in Figure 6-1.

The LDM-256 is also capable of operating opposite any 511 BERT tester. When you use one LDM-256 opposite another, either with one or both PATT buttons pressed (see Figure 6-2) or with an external BERT transmitting the same V.52 (511-bit) pattern, you can test the complete link. To activate the BERT, press the PATT button. The ERR LED will light momentarily, just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

NOTE

For the LDM-256's BERT to operate correctly, the CARRIER jumper must be set to ON or the RTS signal must be high.

While PATT is depressed, the V.35 interface is functionally disconnected.

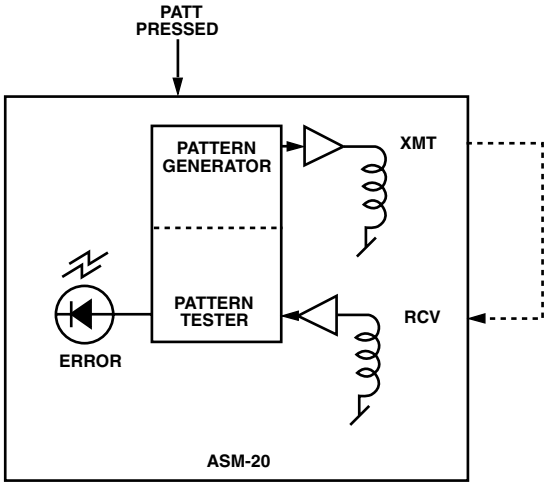

Figure 6-1. BERT using loops.

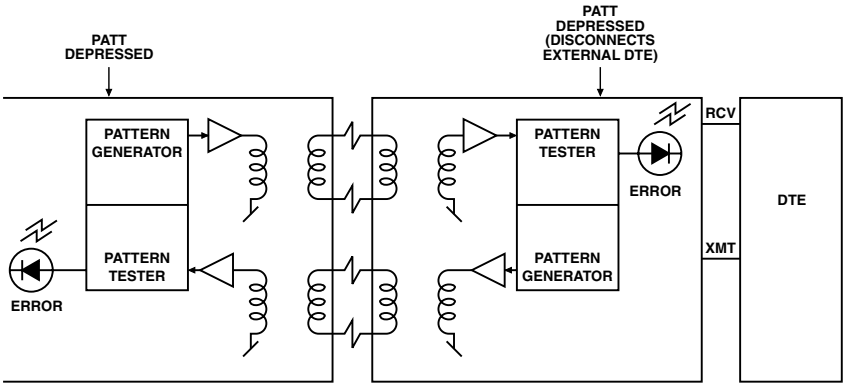

Figure 6-2. Two LDM-256s doing end-to-end BERT.

6.3 The Modem Self-Test

To verify that the LDM-256 itself is operating correctly, initiate the modem self-test by pressing the PATT and ANA buttons (refer to Figure 6-3 below):

1. Press ANA to start local analog loopback. Both the TEST and DCD LEDs should light. If the DCD LED doesn't light, make sure that the RTS signal is not OFF (low) while the CARRIER jumper is OFF.

2. Press PATT to begin test-pattern transmission. Verify that the TEST and DCD LEDs are still lit and that the ERR LED lights briefly.

3. If the ERR stays lit or continues to flicker after the initial flash, the LDM-256 is faulty; call Black Box to arrange for repair or replacement. Otherwise, the unit passes the test; restore all of the buttons to their normal positions.

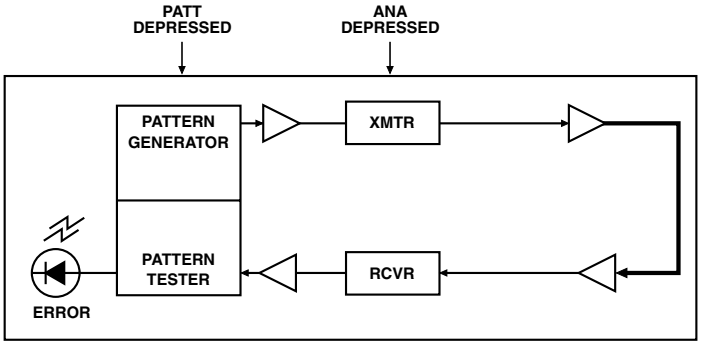

Figure 6-3. Modem self-test.

6.4 Local Analog Loopback

Activate the local analog loopback test by pressing the ANA button or by raising the level of the Local Loopback signal received by the LDM-256's V.35 connector (Pin JJ). This test checks the performance of the local LDM-256's modem, the local DTE, and the connections between them. Perform this test separately at the local and remote sites (refer to Figure 6-4):

1. Press ANA or raise Local Loopback to start local analog loopback. The TEST LED should light. The LDM-256's G.703 transmit output should be connected to its own receiver.
2. Verify that the DTE is operating properly and can be used for a test.
3. Perform the test using one of these methods:
   - Send data from the DTE and check the echoed data stream.
   - Hook up an external Bit Error Rate Test (BERT) unit in place of the DTE.
   - Use the LDM-256's internal BERT. Press the PATT button.The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).
4. Repeat Steps 1 through 3 at the remote site.
5. If the BERT tests show no errors, but the data echoed back to either DTE is bad, check the DTE and the cable connecting it to the LDM-256—one of them is faulty.
6. After the test is complete or the fault has been corrected, restore the ANA button to its normal position. Proceed with the digital loopback tests.

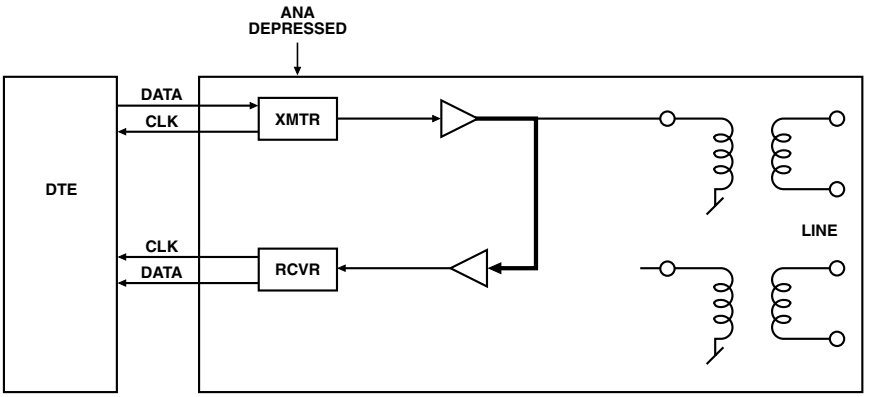

Figure 6-4. Local analog loopback.

6.5 Remote Digital Loopback

Activate the remote digital loopback test by pressing the REM button or by raising the level of the Remote Loopback signal received by the LDM-256's V.35 connector (Pin HH). This test involves creating an outbound loopback at the remote LDM-256 (see Figure 6-5). The test checks the performance of the local and remote units and the line between them:

1. Press REM or raise Remote Loopback; the local LDM-256 will signal the remote unit to start remote digital loopback. The TEST LED should light on both units. The remote LDM-256's receive input should be connected to its own transmitter.

2. Perform a Bit Error Rate Test (BERT). Either:

   - Hook up an external Bit Error Rate Test (BERT) unit in place of the local DTE; or

   - Use the local LDM-256's internal BERT. Press the PATT button. The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

3. If the BERT test indicates a fault, but both LDM-256s pass their modem self-tests (see **Section 6.3**), there is a problem somewhere in the communication line between the units.

4. After the test is complete or the fault has been corrected, restore the REM button to its normal position. Proceed with local digital loopback.

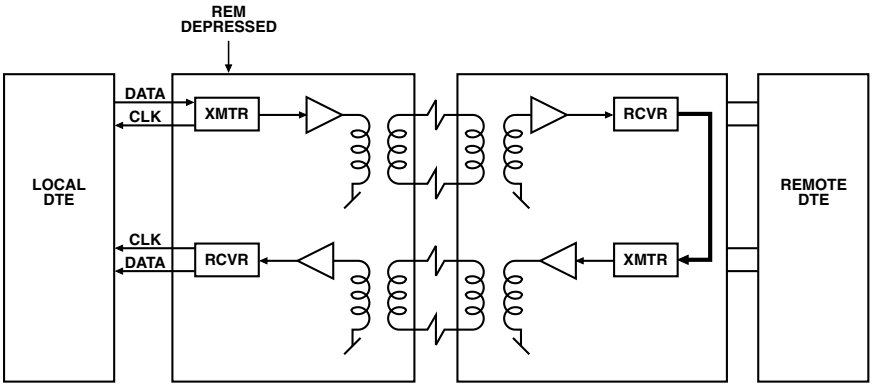

Figure 6-5. Remote digital loopback.

6.6 Local Digital Loopback

Activate the local digital loopback test by pressing the DIG button on the LDM-256's front panel. This test involves creating an outbound loopback at the local LDM-256 (see Figure 6-6). It works the same way as if the remote operator had initiated a remote digital loopback at the remote site. With this test, the remote operator can check the performance of the remote and local LDM-256s and the line between them:

1. Press DIG; the local LDM-256 will signal the remote unit and will start local digital loopback. The TEST LED should light on both units. The local LDM-256's receive input should be connected to its own transmitter.

2. Perform a Bit Error Rate Test (BERT). Either:

- Hook up an external BERT unit in place of the remote DTE; or
- Use the remote LDM-256's internal BERT. Press the PATT button. The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

3. If the BERT test indicates a fault, but both LDM-256s pass their modem self-tests (see **Section 6.3**), there is a problem somewhere in the communication line between the units.

4. After the test is complete or the fault has been corrected, restore the DIG button to its normal position.

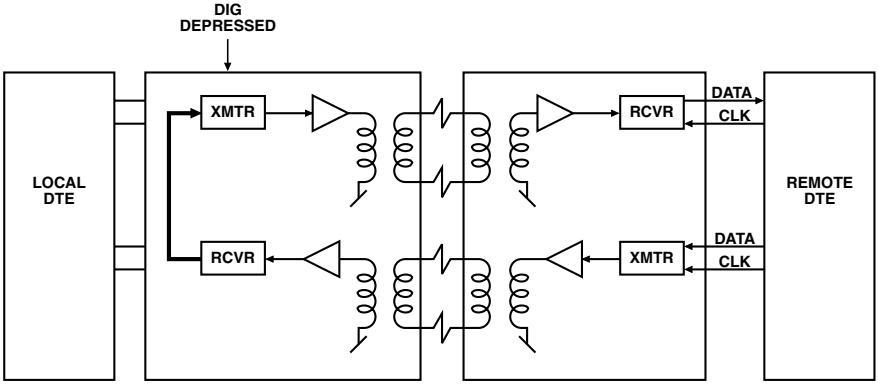

Figure 6-6. Local digital loopback.

6.7 Calling Black Box

If you determine that your LDM-256 is malfunctioning, *do not attempt to alter or repair the unit.* It is not user-serviceable. Contact Black Box Technical Support at 724-746-5500; the problem might be solvable over the phone.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

6.8 Shipping and Packaging

If you need to transport or ship your LDM-256:

- Package it carefully. We recommend that you use the original container.
- Before you ship the LDM-256 for repair or return, contact Black Box to get a Return Authorization (RA) number.

Appendix: Maximum Distances

The maximum distance that a pair of LDM-256s can communicate across will vary depending on the data rate and the thickness (gauge) of the wires. In multipoint applications, it will also vary depending on the number of slaves on the line. Approximate maximum distances for different combinations of these factors are listed in the tables below. Please be aware that these numbers are only approximations; the distances shown might not be attainable for all applications. Also, maximum distances will always be less than those listed when LDM-256s are used in noisy environments.

Point-to-point applications

Data Rate	19 AWG	22 AWG	24 AWG
19.2 kbps	11.8 mi. (19 km)	7.2 mi. (11.5 km)	5 mi. (8 km)
32 kbps	11.8 mi. (19 km)	7.2 mi. (11.5 km)	5 mi. (8 km)
48 kbps	11.2 mi. (18 km)	6.8 mi. (11 km)	4.7 mi. (7.5 km)
56 kbps	11.2 mi. (18 km)	6.8 mi. (11 km)	4.7 mi. (7.5 km)
64 kbps	11.2 mi. (18 km)	6.8 mi. (11 km)	4.7 mi. (7.5 km)
72 kbps	10.9 mi. (17.5 km)	6.5 mi. (10.5 km)	4.5 mi. (7.2 km)
96 kbps	9.3 mi. (15 km)	5.5 mi. (8.8 km)	3.8 mi. (6.1 km)
112 kbps	8.1 mi. (13 km)	5 mi. (8 km)	3.4 mi. (5.5 km)
128 kbps	7.5 mi. (12 km)	4.5 mi. (7.3 km)	3.1 mi. (5 km)
144 kbps	6.9 mi. (11 km)	4 mi. (6.4 km)	2.8 mi. (4.5 km)
192 kbps	5.6 mi. (9 km)	3.3 mi. (5.3 km)	2.3 mi. (3.7 km)
256 kbps	3.7 mi. (6 km)	2.2 mi. (3.6 km)	1.6 mi. (2.5 km)

Multipoint applications
(24 AWG cable, 64 kbps)

5 slaves	4.3 mi. (7 km)
10 slaves	3.7 mi. (6 km)
15 slaves	3.1 mi. (5 km)
25 slaves	2.5 mi. (4 km)
40 slaves	1.2 mi. (2 km)

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